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(54) Title: ELECTROLYTE AND BATTERY COMPRISING SAME

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(54) ELECTROLYTE AND BATTERY COMPRISING SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electrolyte capable of establishing an excellent chemical stability and thermochemical stability, and a lithium secondary battery using the electrolyte.

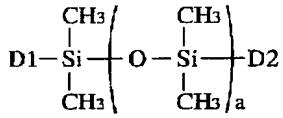
SOLUTION: The electrolyte of the lithium secondary battery contains a siloxane derivative expressed by Formula (1) and electrolyte salts. Siloxane derivative has a high chemical stability and is fire retardant or with a low vapor pressure, so that it excels also in terms of thermochemistry. Formula (1) where a is

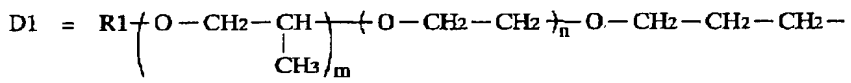
integer of 1-50, m, n, q, r are integers of 0-40, R1 and R2 are H, alkyl group or a substituted alkyl group in which at least one hydrogen is substituted with halogen.

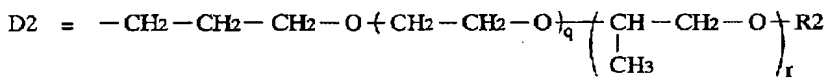
[What is Claimed is]

[Claim 1] An electrolyte comprising a siloxane derivative shown by following formula 1, and an electrolyte salt.

[Formula 1]







(wherein, a expresses the integer of 1 to 50, m, n, q, r are independently integers of 0-40, and R1 and R2 independently express H, alkyl group or a substituted alkyl group in which at least one hydrogen is substituted with halogen.)

[Claim 2] The electrolyte according to claim 1, wherein the siloxane derivatives has the coefficients of kinematic viscosity of less than or equal to 5000mm^2 / s at 25℃.

[Claim 3] The electrolyte according to claim 1, wherein the siloxane derivative

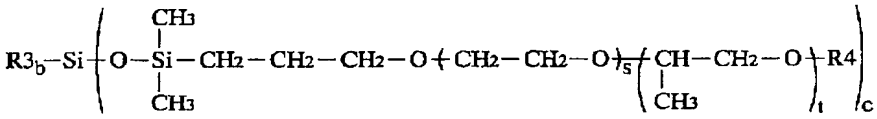
has weight average molecular weight being 10000 or less.

[Claim 4] The electrolyte according to claim 1, wherein the electrolyte salt is a lithium salt.

[Claim 5] The electrolyte according to claim 1 characterized by the conductivity of 0.01 S/m or more at 25℃.

[Claim 6] An electrolyte comprising a siloxane derivative shown by following formula 2, and an electrolyte salt.

[Formula 2]



(wherein b expresses the integer of 0 to 3, c expresses the integer of 1 to 4, b+c is surely 4 and s and t expresses the integer of 0 to 40, respectively, R3 is a methyl group and R4 expresses hydrogen, alkyl group, or alkyl group in which at least one hydrogen is substituted with halogen.

[Claim 7] The electrolyte according to claim 6, wherein the siloxane derivative has the coefficients of kinematic viscosity viscosity of less than or equal to 5000mm^2 / s at 25℃.

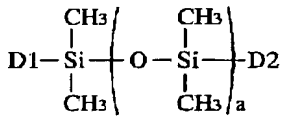
[Claim 8] The electrolyte according to claim 6, wherein the siloxane derivative has weight average molecular weight being 10000 or less.

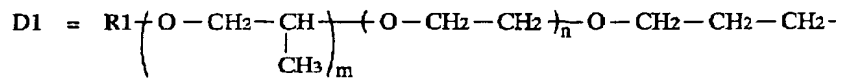
[Claim 9] The electrolyte according to claim 6, wherein the electrolyte salt is lithium salt.

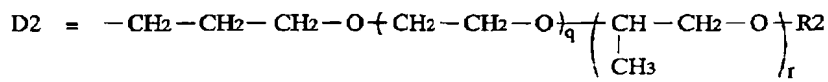
[Claim 10] The electrolyte according to claim 6 characterized by the conductivity of 0.01 S/m or more at 25 ℃.

[Claim 11] A battery comprising a positive electrode, a negative electrode, and an electrolyte comprising a siloxane derivative and electrolyte salt which are shown by following formula 3.

[Formula 3]







(wherein a expresses the integer of 1 to 50, m, n, q, and r expresses the integer of 0 to 40, respectively, and R1 and R2 express H, alkyl group or a substituted

alkyl group in which at least one hydrogen is substituted with halogen.)

[Claim 12] The battery according to claim 11, wherein the electrolyte comprise the siloxane derivative having the coefficient of kinematic viscosity viscosity of less than or equal to 5000mm^2 / s at 25℃.

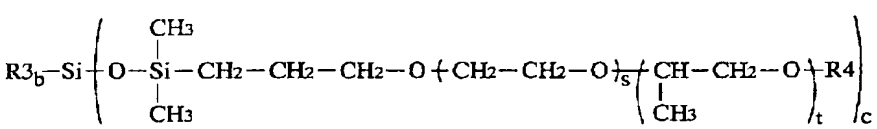
[Claim 13] The battery according to claim 11, the electrolyte comprise the siloxane derivative having weight average molecular weight of 10000 or less.

[Claim 14] The battery according to claim 11, wherein the electrolyte has the conductivity of 0.01 S/m or more at 25℃.

[Claim 15] The battery according to claim 11, wherein the positive electrode comprise a oxides or sulfides into which lithium ion is intercalated or deintercalated, and the negative electrode comprise a material in which lithium is intercalated or deintercalated, or lithium metal

[Claim 16] A battery comprising a positive electrode, a negative electrode, and an electrolyte comprising a siloxane derivative and electrolyte salt which are shown by following formula 4.

[Formula 4]



(wherein b expresses the integer of 0 to 3, c expresses the integer of 1 to 4, b+c is surely 4 and s and t expresses the integer of 0 to 40, respectively.) R3 is a methyl group and R4 expresses hydrogen, alkyl group, or alkyl group in which at least one hydrogen is substituted with halogen.

[Claim 17] The battery according to claim 16, wherein the electrolyte has the coefficient of kinematic viscosity of less than or equal to 5000mm^2 /s at 25℃.

[Claim 18] The battery according to claim 16, wherein the electrolyte comprise the siloxane derivative having weight average molecular weight of 10000 or less.

[Claim 19] The battery according to claim 16, wherein the electrolyte has the conductivity of 0.01 S/m or more at 25℃.

[Claim 20] The secondary lithium battery according to Claim 16, wherein the positive electrode comprises oxides or sulfides into which lithium ion is intercalated or deintercalated, and the negative electrode comprise a material into which lithium is intercalated or deintercalated, or lithium metal.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the cell using the electrolyte and it containing an electrolyte salt and a solvent.

[0002]

[Description of the Prior Art] Recent years come and portable electrical and electric equipment products, such as a camera one apparatus video tape recorder, a cellular phone, or a laptop computer, are spreading quickly. Moreover, the viewpoint of an environmental problem to NOx etc. development of the electric vehicle which does not discharge exhaust gas in air has come to be taken up as a social technical problem. The researches and developments about the cell as a portable power source and a clean energy source, especially a rechargeable battery are actively furthered under such a situation. Since high energy density is obtained as compared with the lead (Pb) rechargeable battery or nickel cadmium (nickel-Cd) rechargeable battery which is the conventional drainage system electrolytic-solution rechargeable battery, the rechargeable battery (lithium secondary battery) which used the lithium (Li) or the lithium ion (Li^+) especially attracts great expectation.

[0003] As the electrolyte of this lithium secondary battery, a solution in which an electrolyte salt, LiPF6 etc. is dissolved in non aqueous solvents, such as carbonates, such as low-molecular ethylene carbonate, propylene carbonate, or diethyl carbonate, is widely used because of being comparatively high conductivity, and being stable also in potential.

[0004] However, although the lithium secondary battery using such an electrolyte is highly efficient, since the inflammable organic solvent is used, a problem may arise in safety. For example, the high current may have flowed and generated heat in the cell rapidly at the time of the short circuit of a current, and breakage, a burst, or ignition of a cell may have taken place for the generation of gas according to evaporation or decomposition of the organic solvent in the electrolyte. Then, in order to prevent these conventionally, the safety practice was performed by preparing a relief valve or a current interrupting device etc. which will cleave if the pressure in a cell rises.

[0005]

[Problem(s) to be Solved by the Invention] However, since safety was secured by improving structure devices, such as a relief valve, conventionally, while structure will be complicated, only the part of those structures had the problem

that the magnitude of a cell will become large. Then, to improve a cell ingredient fundamentally is desired.

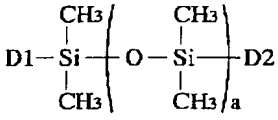
[0006] This invention was made in view of this trouble, and the 1st purpose is in offering the electrolyte excellent in chemical stability and thermochemical stability.

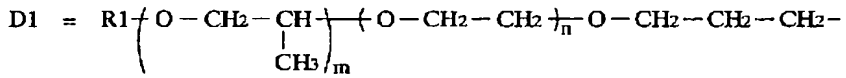
[0007] Moreover, the 2nd purpose of this invention is by controlling electrolytic evaporation or decomposition to offer the cell which prevented the breakage or ignition of a cell by generating of gas, and was excellent in the cell engine performance.

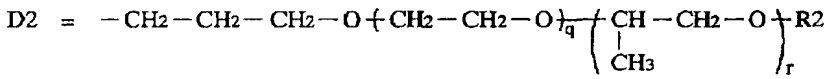
[0008]

[Means for Solving the Problem] The 1st electrolyte by this invention contains the siloxane derivative shown by following formula 5, and an electrolyte salt.

[Formula 5]



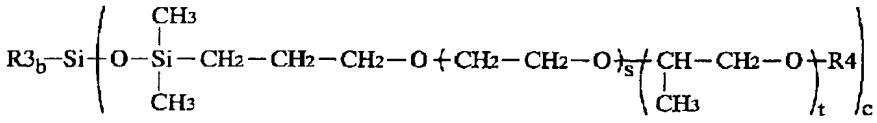




(a expresses the integer of 1 to 50 among a formula, m, n, q, and r expresses the integer of 0 to 40, respectively, and R1 and R2 express the radical by which a part of hydrogen atom [at least] contained in a hydrogen atom, an alkyl group, or an alkyl group was permuted by the halogen atom, respectively.)

[0009] The 2nd electrolyte by this invention contains the siloxane derivative shown by following formula 6, and an electrolyte salt.

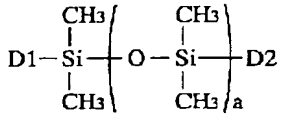
[Formula 6]

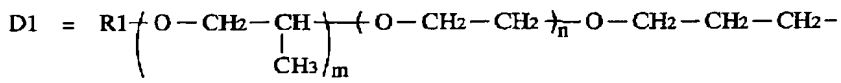


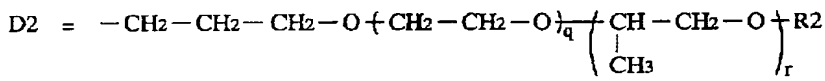
(b expresses the integer of 0 to 3 among a formula, c expresses the integer of 1 to 4, b+c is surely 4 and t expresses the integer of s and0 to 40, respectively.) R3 is a methyl group and R4 expresses hydrogen, alkyl group, or alkyl group in which at least one hydrogen is substituted with halogen.

[0010] The 1st cell by this invention is equipped with an electrolyte with a positive electrode and a negative electrode, and an electrolyte contains the siloxane derivative and electrolyte salt which are shown by following formula 7.

[Formula 7]



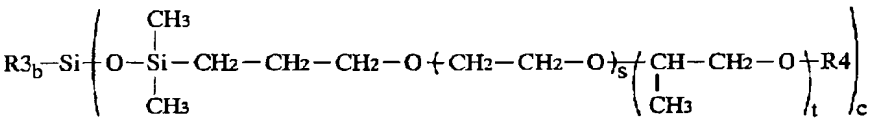




(wherein a expresses the integer of 1 to 50, m, n, q, and r expresses the integer of 0 to 40, respectively, and R1 and R2 express H, alkyl group or a substituted alkyl group in which at least one hydrogen is substituted with halogen, respectively.)

[0011] The 2nd cell by this invention is equipped with an electrolyte with a positive electrode and a negative electrode, and an electrolyte contains the siloxane derivative and electrolyte salt which are shown by following formula 8.

[Formula 8]



(wherein b expresses the integer of 0 to 3, c expresses the integer of 1 to 4, b+c is surely 4 and s and t expresses the integer of 0 to 40, respectively, R3 is a methyl group and R4 expresses hydrogen, alkyl group, or alkyl group in which at least one hydrogen is substituted with halogen.

[0012] In the 1st or 2nd electrolyte by this invention, since the siloxane derivative shown in formula 5 or formula 6 is included, chemical stability is high, and since it is fire retardancy or low vapor pressure, the also thermochemically excellent property can be acquired.

[0013] By the 1st or 2nd cell by this invention, since the electrolyte contains the siloxane derivative shown in formula 7 or formula 8, evaporation or decomposition cannot take place easily at the time of the short circuit of a current, breakage or ignition of a cell is prevented, and the cell engine performance which was excellent also in the high voltage is shown.

[0014]

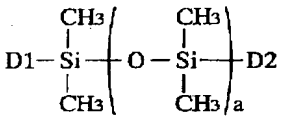
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

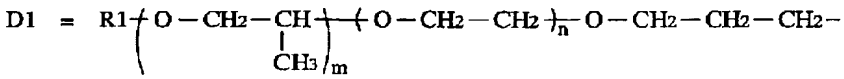
[0015] The electrolyte concerning the gestalt of 1 operation of this invention contains the solvent and the electrolyte salt. A solvent makes an electrolyte

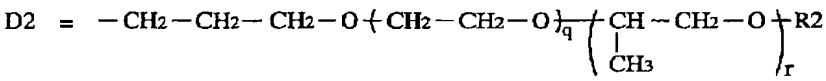
salt dissolve and dissociate. The solvent contains at least one side of the siloxane derivatives shown in formula 9 or formula 10.

[0016]

[Formula 9]



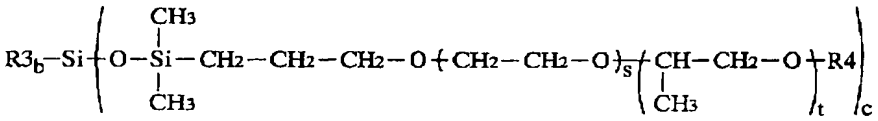




(wherein a expresses the integer of 1 to 50, m, n, q, and r expresses the integer of 0 to 40, respectively, and R1 and R2 express H, alkyl group or a substituted alkyl group in which at least one hydrogen is substituted with halogen, respectively.) In addition, a value which is different also with the same value is sufficient as m, n, and q and r, and even if R1 and R2 are the same, they may differ.

[0017]

[Formula 10]



(wherein b expresses the integer of 0 to 3, c expresses the integer of 1 to 4, b+c is surely 4 and s and t expresses the integer of 0 to 40, respectively, R3 is a methyl group and R4 expresses hydrogen, alkyl group, or alkyl group in which at least one hydrogen is substituted with halogen. In addition, a value which is different also with the same value is sufficient as s and t.

[0018] These siloxanes derivative is the shape of chain type inorganic polymer with which it had the chain combination of silicon (Si) and oxygen (O) in the basic frame, and the side chain which is a univalent organic radical was added to silicon. These siloxanes derivative has high chemical stability, and since it is fire retardancy or low vapor pressure, it has the property of excelling also in thermochemical stability.

[0019] As for the coefficient of kinematic viscosity in the temperature of 25℃ of these siloxanes derivative, it is desirable that they are below 5000mm^2 / s (5000cSt), and, as for weight average molecular weight, it is desirable that it is 10000 or less. In order to use as an electrolytic solvent, it is because viscosity

is comparatively low and it is required to dissolve an electrolyte salt. A coefficient of kinematic viscosity and weight average molecular weight are prepared choosing the value of a, m, n, q, and r shown in formula 9, or by choosing the value of b, c, s, and t shown in formula 10. For example, if it is the siloxane derivative shown in formula 9, it is desirable to make a into the integer of 1 to 20 within the limits.

[0020] As an electrolyte salt, a light metal salt is mentioned, for example. There is alkaline-earth-metal salts, such as alkali-metal salts, such as lithium salt, a sodium (Na) salt, or a potassium (K) salt, a magnesium (Mg) salt, or a calcium (calcium) salt, or an aluminum (aluminum) salt as light metal salt, and one sort or two or more sorts are chosen according to the purpose. For example, if it is lithium salt $LiBF_4$, $LiClO_4$, $LiPF_6$, $LiAsF_6$, CF_3SO_3Li, $(CF_3SO_2)_2NLi$, $C_4F_9\ SO_3Li$, CF_3CO_2Li, $(CF_3CO_2)_2NLi$, and $C_6F_5SO_3Li$, $C_8F_{17}SO_3Li$, $(C_2F_5SO_2)_2NLi$, $(C_4F_9SO_2)(CF_3SO_2)NLi$, $((FSO_2C_6F_4)(CF_3SO_2)NLi$, $((CF_3)_2CHOSO_2)_2NLi$, $(CF_3SO_2)_3CLi$, $(C_6F_3(CF_3)_2\text{-}3.5)_4BLi$, $LiCF_3$ or $LiAlCl_4$. It is mentioned, and 1 of any sorts of these and two sorts or more are mixed, and are used.

[0021] In addition, as for the conductivity in the temperature of 25℃ of this

electrolyte, it is desirable that they are 0.01 or more S/m, and it is adjusted by the class of electrolyte salt, or its concentration.

[0022] Moreover, in addition to the siloxane derivative mentioned above, this electrolyte may contain other solvents. As other solvents, propylene carbonate, ethylene carbonate, diethyl carbonate, methylethyl carbonate, 1, 2-dimethoxyethane, 1, 2-diethoxy ethane, gamma-butyrolactone, a tetrahydrofuran, 1, 3-dioxolane, dipropyl carbonate, diethylether, a sulfolane, a methyl sulfolane, an acetonitrile, propionitrile, an anisole, acetic ester, or propionic-acid ester is mentioned, and any these one sort or two sorts or more are mixed, and are used, for example.

[0023] The electrolyte which has such a configuration is used for a cell as follows. Here, the example of a lithium secondary battery is given and it explains below with reference to a drawing.

[0024] FIG.1 expresses the cross-section structure of the rechargeable battery using the electrolyte concerning the gestalt of this operation. This rechargeable battery is called so-called coin mold, and the laminating of the disc-like negative electrode 12 held in the sheathing cup 11 and the disc-like positive electrode 14 held in the sheathing can 13 is carried out through a

separator 15. The interior of the sheathing cup 11 and the sheathing can 13 is filled with the electrolyte 16 according to the embodiment of the present invention, section / of the sheathing cup 11 and the sheathing can 13 / periphery is sealed by the gasket 17.

[0025] The negative electrode 12 contains a material into which lithium is intercalated or deintercalated, or lithium metal as a negative active material, and contains binders, such as polyvinylidene fluoride, further if needed.

[0026] Considering the material into which lithium is intercalated or deintercalated, carbon material, a metallic oxide, or polymeric materials is mentioned. As a carbon material, what was prepared in predetermined temperature and predetermined ambient atmospheres, such as carbon black, such as corks, such as pyrolytic carbon, petroleum coke, or pitch coke, artificial graphites, natural graphites, and acetylene black, glassy carbon, an organic polymeric-materials baking object, or a carbon fiber, is mentioned, for example. In addition, an organic polymeric-materials baking object calcinates organic polymeric materials at the suitable temperature of 500℃ or more in an inert gas ambient atmosphere or a vacuum. Moreover, as a metallic oxide, ferrous oxide, ruthenium oxide, or molybdenum oxide is mentioned, and polyacethylene

or polypyrrole is mentioned as polymeric materials.

[0027] Considering the material into which lithium is intercalated or deintercalated, the simple substance of the metallic element which can form a lithium and an alloy, or metalloid element, an alloy, or a compound is also mentioned. In addition, the thing which becomes an alloy from two or more sorts of metallic elements in this specification, in addition, what consists of one or more sorts of metallic elements and one or more sorts of metalloid element is included. The solid solution, an eutectic (eutectic mixture), intermetallic compounds, or those things with which it strikes and two or more sorts coexist are in the organization.

[0028] As such a metallic element or metalloid element For example, tin (Sn), lead (Pb), aluminum, an indium (In), Silicon, zinc (Zn), copper (Cu), cobalt (Co), antimony (Sb), A bismuth (Bi), cadmium (Cd), magnesium, boron (B), a gallium (Ga), germanium (germanium), an arsenic (As), silver (Ag), a hafnium (Hf), a zirconium (Zr), and an yttrium (Y) are mentioned. As these alloys or a compound, they are a chemical formula Mad Mbe Lif or a chemical formula Mag Mch Mdi, for example. What is expressed is mentioned. In these chemical formulas, Ma expresses at least one sort in the metallic element which can form

a lithium and an alloy, and metalloid element, Mb expresses at least one sort in metallic elements other than a lithium and Ma, and metalloid element, Mc expresses at least one sort of a nonmetallic element, and Md expresses at least one sort in metallic elements other than Ma, and metalloid element. Moreover, the values of d, e, f, g, h, and i are d> 0, e>=0, f>=0, g> 0, h> 0, and i>=0, respectively.

[0029] Especially, silicon, tin, these alloys, or a compound has desirable especially desirable simple substance of 4B group's metallic element, or metalloid element, alloy, or compound. As for these, the thing of a crystalline substance may also be amorphous.

[0030] The examples of the alloy and compound are LiAl, AlSb, CuMgSb, SiB_4, SiB_6, Mg_2Si, Mg_2Sn and Ni_2Si, $TiSi_2$, $MoSi_2$, and $CoSi_2$, $NiSi_2$, $CaSi_2$, $CrSi_2$, Cu_5Si, and $FeSi_2$, $MnSi_2$, $NbSi_2$, $TaSi_2$, VSi_2, WSi_2, $ZnSi_2$, SiC, Si_3N_4, Si_2N_2O, SiO_v (0< v<=2), SnO_w (0< w<=2), $SnSiO_3$, LiSiO, or LiSnO.

[0031] As the material into which lithium is intercalated or deintercalated, any these one sort or two sorts or more may be mixed, and a lithium may be used.

[0032] The positive electrode 14 contains positive active material, and contains electric conduction agents, such as carbon black or graphite, and binders, such

as polyvinylidene fluoride, further if needed.

[0033] As positive active material, the material into which lithium is intercalated or deintercalated, and any these one sort or two sorts or more are used. The examples are metallic sulfide or oxide which does not contain a lithium such as TiS_2 and MoS_2 or V_2O_5 etc, or lithium composite oxide containing lithium, or $NbSe_2$ etc. In order to make an energy density high especially, it is preferably lithium composite oxide such as Li_xMO_2. The lithium composite oxide made into a subject is desirable. In addition, one or more kinds of transition-metals elements of M are desirable, and, specifically, its at least one sort in cobalt, nickel (nickel), and manganese (Mn) is desirable. Moreover, x is usually the value of $0.05 \leq x \leq 1.10$. The examples of lithium composite oxide are $LiCoO_2$, $LiNiO_2$, $Li_xNi_yCo_{1-y}O_2$(the value of x and y changes with charge-and-discharge conditions of a cell, and are usually $0< x<1$ and $0.7< y \leq 1$.) or $LiMn_2O_4$ etc.

[0034] In addition, this lithium multiple oxide carries out grinding mixing according to the presentation of a request of the carbonate of a lithium, a nitrate, an oxide or a hydroxide, and the carbonate of transition metals, a nitrate, an oxide or a hydroxide, and is prepared by calcinating in an oxygen ambient

atmosphere at the temperature within the limits of 600℃ to 1000℃.

[0035] A separator 15 isolates a negative electrode 12 and a positive electrode 14, it passes a lithium ion, preventing the short circuit of the current by contact of two poles, and is constituted by a nonwoven fabric, a ceramic film, or porosity thin film films made of synthetic resin, such as polytetrafluoroethylene, polypropylene, or polyethylene, etc.

[0036] The rechargeable battery which has such a configuration acts as follows.

[0037] In this rechargeable battery, if it charges, a lithium ion will secede from a positive electrode 14, a separator 15 will be passed through an electrolyte 16, and occlusion will be carried out to a negative electrode 12. Then, if it discharges, a lithium ion will secede from a negative electrode 12, a separator 15 will be passed through an electrolyte 16, and return occlusion will be carried out to a positive electrode 14. Here, since the siloxane derivative shown in formula 9 or formula 10 as a solvent is included, an electrolyte 16 has high chemical stability, and since it is fire retardancy or low vapor pressure, it is thermochemically excellent electrolyte. Therefore, evaporation or decomposition cannot take place easily at the time of the short circuit of a current, breakage or ignition of a cell is prevented, and the cell engine

performance which was excellent also in the high voltage is shown.

[0038] Thus, since the siloxane derivative shown in formula 9 or formula 10 as a solvent is included according to the electrolyte concerning the gestalt of this operation, chemical stability and thermochemical stability can be made high. Therefore, if a cell is constituted using this electrolyte, even if a high current flows rapidly at the time of the short circuit of a current, electrolytic evaporation or decomposition can be controlled. Therefore, breakage or ignition of a cell can be prevented, and while being able to as if safety is raised, the cell engine performance which was excellent also in the high voltage can be obtained.

[0039] Moreover, if it is made to make below 5000mm^2 / s, or weight average molecular weight for the coefficient of kinematic viscosity in the temperature of 25℃ of the siloxane derivative shown in formula 9 or formula 10 or less into 10000, the good electrolyte which the ion which could dissolve sufficient electrolyte salt to pull out high conductivity, and was produced by dissociation of an electrolyte salt can move can be obtained.

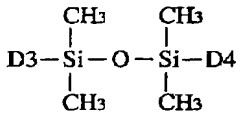
[0040]

[Example] Furthermore, the concrete example of this invention is explained to a detail.

[0041] (Example 1-1 to 1-3) As a solvent, weight average molecular weight prepared the siloxane derivative shown in formula 11 which is 631, added $(CF_3SO_2)_2NLi$ as lithium salt to this, and produced the electrolyte. In that case, in the example 1-1 to 1-3, the addition of 2 NLi to 1g of siloxane derivatives was changed, as shown in Table 1. In addition, it sets in the chemical formula shown in formula 9, and the siloxane derivative shown in formula 11 is a= 1, m= 0, n= 4, q= 4, r= 0, and R1=CH_3. And R2=CH_3. The siloxane derivative had the coefficients of kinematic viscosity of 16mm²/s at 25℃.

[0042]

[Formula 11]



D3 = $CH_3-(O-CH_2-CH_2)_4-O-CH_2-CH_2-CH_2-$

D4 = $-CH_2-CH_2-CH_2-O-(CH_2-CH_2-O)_4-CH_3$

[0043]

[Table 1]

	シロキサン誘導体 1g に対する $(CF_3SO_2)_2NLi$ の添加量(mol)	導電率 (25℃) (S/m)
実施例 1-1	0.5	0.0266
実施例 1-2	1.0	0.0383
実施例 1-3	1.5	0.0323
比較例 1-1	0.5	0.0021
比較例 1-2	1.0	0.0041

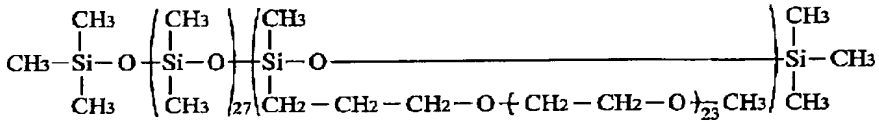
[0044] About the electrolyte of the acquired example 1-1 to 1-3, the ion conductivity trial was performed, respectively. By ion conductivity trial, it is an electrolyte the thickness of 0.145cm, and an area of 0.7854cm^2. It inserted with the stainless plate, the electrical potential difference was impressed, and it asked for conductivity from the so-called Cole-Cole plot which expressed the sinusoidal alternating voltage to impress with the symbolic method (complex notation). The obtained result is shown in Table 1.

[0045] Moreover, except for having used the siloxane derivative shown in formula 12 whose weight average molecular weight is 3310, others produced the electrolyte like this example as a solvent as the example 1-1 of a comparison over this example, and 1-2. In that case, by the example 1-1 of a comparison, and 1-2, the addition of $(CF_3SO_2)_2NLi$ to 1g of siloxane derivatives

was changed, as shown in Table 1. It asked for conductivity about the example 1-1 of a comparison, and the electrolyte of 1-2 as well as this example. These results are also shown according to Table 1. In addition, the example 1-1 of a comparison corresponds to an example 1-1, and the example 1-2 of a comparison supports the example 1-2.

[0046]

[Formula 12]



[0047] As shown in Table 1, according to this example, conductivity was higher than the example 1-1 of a comparison, and 1-2, and the conductivity which can be used for a cell etc. was acquired.

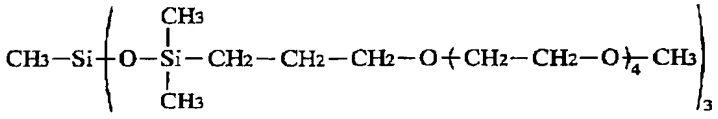
[0048] Furthermore, the test cell of a coin mold as shown in FIG. 1 was produced using the electrolyte of the acquired example 1-2, the charge and discharge test was performed, and the discharge property was investigated. In the positive electrode of a test cell, it is LiCoO2. It used and the carbon material was used for the negative electrode. They set the discharge current

to 100microA for the upper limit electrical potential difference, having set 4.2V and a minimum electrical potential difference as 3.0V, and charge and discharge repeated it up to 20 cycles. The charge-and-discharge curve obtained as a result is shown in FIG. 2. FIG. 2 showed that the cell using this electrolyte had sufficient charge-and-discharge property. Therefore, when using the electrolyte containing the siloxane derivative shown in formula 11, it turned out that the outstanding cell engine performance can be obtained.

[0049] (Example 2-1 to 2-6) As an example 2-1 to 2-3, others produced the electrolyte like the example 1-1 except for having used the siloxane derivative shown at formula 13 whose weight average molecular weight is 1014 to the solvent. In that case, in the example 2-1 to 2-3, the addition of $(CF_3SO_2)_2NLi$ to 1g of siloxane derivatives was changed, as shown in Table 2. In addition, it sets in the chemical formula shown in formula 10, and the siloxane derivative shown in formula 13 is b= 1, c= 3, s= 4, t= 0, and R4=CH_3. The siloxane derivative had coefficients of kinematic viscosity of 23mm^2/S at 25℃.

[0050]

[Formula 13]



[0051]

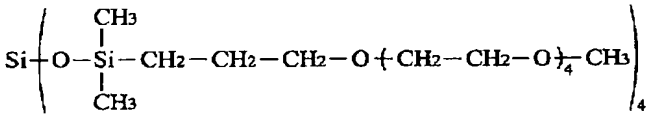
[Table 2]

	シロキサン誘導体 1g に対する $(CF_3SO_2)_2NLi$ の添加量(mol)	導電率 (25℃) (S/m)
実施例 2-1	0.5	0.0192
実施例 2-2	1.0	0.0272
実施例 2-3	1.5	0.0221
比較例 1-1	0.5	0.0021
比較例 1-2	1.0	0.0041

[0052] Moreover, except for having used the siloxane derivative shown at formula 14 whose weight average molecular weight is 1322, others produced the electrolyte like the example 1-1 as an example 2-4 to 2-6 to the solvent. In that case, in the example 2-4 to 2-6, the addition of $(CF_3SO_2)_2NLi$ to 1g of siloxane derivatives was changed, as shown in Table 3. In addition, it sets in the chemical formula shown in formula 10, and the siloxane derivative shown in formula 14 is b= 0, c= 4, s= 4, t= 0, and R4=CH_3. The siloxane derivative had coefficients of kinematic viscosity of 28mm^2/S at 25℃.

[0053]

[Formula 14]



[0054]

[Table 3]

	シロキサン誘導体 1g に対する $(CF_3SO_2)_2NLi$ の添加量(mol)	導電率 (25℃) (S/m)
実施例 2-4	0.5	0.0190
実施例 2-5	1.0	0.0239
実施例 2-6	1.5	0.0186
比較例 1-1	0.5	0.0021
比較例 1-2	1.0	0.0041

[0055] Also about the electrolyte of the acquired example 2-1 to 2-6, the ion conductivity trial was performed like the example 1-1, and it asked for conductivity. The obtained result is shown in Table 2 or 3 together with the example 1-1 of a comparison, and the result of 1-2. In addition, the example 1-1 of a comparison corresponds to an example 2-1 and an example 2-4, and the example 1-2 of a comparison supports the example 2-2 and the example 2-5.

[0056] As shown in Table 2 and 3, according to this example, conductivity was higher than the example 1-1 of a comparison, and 1-2, and the conductivity which can be used for a cell etc. was acquired.

[0057] Furthermore, the test cell of a coin mold as shown in Fig. 1 like the example 1-2 was produced using the electrolyte of the acquired example 2-2, and the discharge property was investigated. The obtained charge-and-discharge curve is shown in FIG. 3. FIG 3 showed that the cell using this electrolyte had sufficient charge-discharge property. Therefore, when using the electrolyte containing the siloxane derivative shown in formula 13, it turned out that the outstanding cell engine performance can be obtained.

[0058] In addition, also except what was shown in formula 11, formula 13, and formula 14, although the siloxane derivative which showed the siloxane derivative shown in formula 11 as a siloxane derivative shown in formula 9 to formula 13 and formula 14 as a siloxane derivative shown in formula 10 was mentioned concretely and the above-mentioned example explained it, if it is the common siloxane derivative expressed with the above-izing 9 or formula 10, the same result can be obtained.

[0059] As mentioned above, although the gestalt and example of operation

were given and this invention was explained, this invention is not limited to the gestalt and example of the above-mentioned implementation, and is variously deformable. For example, in the gestalt and example of the above-mentioned implementation, although the rechargeable battery whose electrode reaction kind is a lithium was explained, this invention is applicable about the cell whose electrode reaction kinds are other light metals, such as alkaline earth metal, such as other alkali metal, such as sodium or a potassium, magnesium, or calcium, or aluminum, similarly. In that case, an electrolyte salt is suitably chosen according to it.

[0060] Moreover, in the embodiment and the example, although the rechargeable battery of a coin mold was explained, this invention is applicable about the thing of other configurations, such as button, paper, a square shape or spiral structure.

[0061] Furthermore, in the gestalt and example of the above-mentioned implementation, although the rechargeable battery was explained, this invention is applicable to other cells, such as a primary cell.

[0062]

[Effect of the Invention] Since the siloxane derivative shown in formula 1 or

formula 2 is included according to the electrolyte given in any 1 of claim 1 to claims 10 as explained above, the effectiveness that chemical stability and thermochemical stability can be made high is done so.

[0063] Since the siloxane derivative has the coefficient of kinematic viscosity of less than or equal to 5000mm^2/S at 25℃, or weight average molecular weight of 10000 or less according to claim 2, claim 3, and the electrolyte according to claim 7 or 8, the effectiveness that the ion which could dissolve sufficient electrolyte salt to pull out high conductivity, and was produced by dissociation can move good is done so.

[0064] Moreover, since it has the electrolyte containing the siloxane derivative shown in formula 3 or *formula 4 according to the cell given in any 1 of claim 11 to claims 20, even if a high current flows rapidly at the time of the short circuit of a current, electrolytic evaporation or decomposition can be controlled. Therefore, while being able to prevent breakage or ignition of a cell and being able to raise safety, the effectiveness that the cell engine performance which was excellent also in the high voltage can be obtained is done so.

[Brief Description of the Drawings]

[FIG 1] It is a sectional view showing the configuration of the rechargeable battery using the electrolyte concerning the gestalt of 1 operation of this invention.

[FIG. 2] It is the property Figure showing the charge and discharge curve in the discharge characteristic test of the electrolyte concerning the example 1-2 of this invention.

[FIG. 3] It is the property Figure showing the charge and discharge curve in the discharge characteristic test of the electrolyte concerning the example 2-2 of this invention.

[Description of Notations]

11 cup; 12 negative electrode; 13 can; 14 positive electrode; 15 separator; 16 An electrolyte, 17 Gasket